

## Seasonal Adjustment of Hybrid Economic Time Series

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### 1. Introduction

State industry employment is estimated monthly from the Current Employment Statistics survey, a sample of about 380,000 employers, and seasonally adjusted with X-11-ARIMA. An annual benchmarking process revises estimates to reflect universe counts available from administrative records of the Unemployment Insurance (UI) programs of each state. At any point in time, the current series consists of universe data through the latest benchmark month followed by sample data up to the current month. A straightforward application of X-11-ARIMA to this hybrid series gives projected seasonal factors which are heavily influenced by the universe data, but which are applied to sample data. Distortions can occur, because the two data sources historically have displayed different seasonal patterns.

Beginning with January 1994 data, the U.S. Bureau of Labor Statistics (BLS) implemented an alternative method that separately adjusts each part of the series, an approach first carried out by Berger and Phillips (1993). The decision to implement the alternative method, which we refer to as the two-step method, was based on the evaluation reported in this paper.

The major users of the employment statistics include the Federal Reserve Board, the President's Council of Economic Advisors, the Joint Economic Committee of Congress, and various other policy-oriented groups. Where economic statistics are used as the basis for their policy analysis, it is important that the preliminary estimates be accurate and that the economic information found in these data be discernible. Highly variable economic series make the interpretation of such data difficult. Furthermore, large annual revisions to the data may also impact the validity of policy analysis conducted on the original estimates, as Berger and Phillips (1994) suggest.

Our analysis of the seasonal adjustment of state industry employment statistics compares the two-step method with the combined method formerly used (Shipp and Sullivan, 1992), i.e., a basic application of X-11-ARIMA to the hybrid series. Our findings are

- there are meaningful differences between universe and sample seasonal patterns,

- the two-step method produces smoother seasonal adjustments, and
- the two-step method results in smaller revisions to the seasonally adjusted data and one- and 12-month change estimates.

We feel these attributes improve the economic interpretation of the data.

### 2. The Current Employment Statistics Survey

The time series from the Current Employment Statistics survey combine available universe employment data with ratio estimates of sample employment. For the period for which the Unemployment Insurance (UI) data are available, the universe value is the time series value,  $AE_t$  ( $t = 1, 2, \dots, T$ ) where  $AE_t$  is the all employees count in month  $t$  and month  $T$  represents the latest benchmark. In the post-benchmark period ( $t > T$ ), for which only sample data are available, a ratio of the sample count in the current month divided by the sample count in the previous month is multiplied by the previous month's employment estimate. Only "matched" reporters are used, i.e., a sample unit's values are used in the ratio only if it reports in the two adjacent months. For  $k > 0$ ,

$$AE_{T+k} = AE_T \cdot \prod_{j=1}^k \frac{ae_{T+j}}{ae_{T+j-1}}$$

where  $ae_{T+j}$  = the sample employee count in month  $T+j$  summed over all matched units. Each year, in the annual benchmark process, the value of  $T$  increases by 12 months as universe values replace sample values..

Statistics Canada's X-11-ARIMA program (Dagum, 1980) is applied to state industry employment series as follows:

- The 1980 version of the program is used, with the automatic option for ARIMA extrapolation.
- Data are adjusted either additively or multiplicatively, depending on which form has better diagnostics.